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The Instruments and Controls Cluster in the Northeast Ohio Region

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A Briefing Paper

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I. Introduction

A. Purpose

The objective of this paper is to provide an overview of the instruments and controls cluster in the Northeast Ohio (NEO) region. The term "cluster" refers to a geographic concentration of interdependent companies, suppliers, products, labor pool, and institutions that together constitute an important competitive advantage for the region. The paper is a starting point for discussion about the priorities of the instruments and controls cluster and what needs to happen for the cluster to prosper in the future. The paper will be used as part of the process in which business leaders, public officials, and community leaders will have the opportunity to take action on top cluster priorities.

This briefing paper is a product of the Regional Economic Development Strategy Initiative. The Greater Cleveland Growth Association, in cooperation with the Akron Regional Development Board, Cleveland Tomorrow, and other Northeast Ohio regional leaders are directing the Project. The Gund and Cleveland Foundations have provided funding.

B. Overview

This briefing paper describes the NEO's instruments and controls cluster, elaborates on its growth potential, and explores possibilities for collaborative action.

In the first section, the paper describes the cluster's size in terms of employment and payroll, as well as the cluster's occupations, relative productivity, and exports. It also describes the intra-cluster relationships, including products, suppliers, distribution channels, final markets, and the community infrastructure that supports the cluster.

The next section describes the potential of the instruments and controls cluster, including external and internal influences, and the requirements for continued vitality of the Insurance cluster in NEO. The last section presents opportunities and ideas for possible collaboration among NEO's instruments and controls companies, universities, and others.

Cluster Description

The Instruments and Controls cluster in Northeast Ohio includes about 140 companies producing a variety of high-tech electronic equipment used in production, new product development, and quality assurance. Products of the cluster include equipment and automation systems which drive and control industrial processes, as well as a variety of testing, measuring, and data acquisition instrumentation.

The cluster is composed of companies producing in two three-digit SIC categories:[1]

- SIC 367, Electronic components and accessories
- SIC 382, Measuring and controlling devices

At the four-digit SIC level, the NEO cluster is mainly composed of the following categories:

- SIC 3625, Relays and industrial controls[2]
- SIC 3672, Printed circuit boards
- SIC 3679, Electronic components, not elsewhere classified
- SIC 3823, Process control instruments
- SIC 3825, Instruments to measure electricity
- SIC 3829, Measuring and controlling devices, not elsewhere classified

These categories cover a variety of industrial instruments and related products for measuring, displaying, transmitting and controlling process variables. These products are used in manufacturing, energy conversion, new product design and development, testing, and quality control.

Characteristics

[1] These categories include the core companies of the cluster, as well as the contract manufacturers and some other suppliers to the core companies.

[2] The three-digit level data presented for the cluster excludes companies in SIC 3625. This is because SIC 362 represents a small proportion of the total employment in the three-digit SIC 362 in Northeast Ohio; there were 14 establishments in SIC 3625 in 1995 out of a total of 56 in SIC 362. Further, the other segments in SIC 362 (motors and generators, and carbon and graphite products) are of a significantly different nature than those of the Instruments and Controls cluster. Therefore, data for SIC 362 would not give an accurate picture of the characteristics of the cluster.

Size and Growth

As shown in Table 1, the NEO Instruments and Controls cluster provided over 8,000 jobs in 1995, adding 665 jobs since 1989, a 9 percent increase. The measuring and controlling devices segment, SIC 382, is more than double the size of the electronic components and accessories segment, SIC 367, with 5,600 jobs compared to 2,400 jobs. Both segments of the cluster grew in employment size over the period.

Although relatively small in size, the cluster is growing faster than the NEO region as a whole and, therefore, growing in importance in the regional economy. The cluster grew 9 percent over the period, while the region as a whole grew only 6.2 percent. This means that the cluster's share of total NEO employment grew slightly from 0.57 in 1989 to 0.58 in 1995. Both segments of the cluster grew faster than the region overall.

In terms of employment concentration in the region, the cluster as a whole is slightly less concentrated in NEO than in the nation as a whole. The location quotient for the cluster is 0.8. However, the measuring and controlling devices segment of the cluster, which is more than twice the size of the other segment, has a higher concentration of employment in the region than in the nation as a whole. The location quotient for this segment is 1.6.

Table 1

SIC	Description	Employment 1995	Location Quotient*	Employment % Change 1989-95	Employment Change 1989-95
	CLUSTER TOTAL	**8,052**	**0.8**	**9.0%**	**665**
367	Electronic Components and Accessories	2,457	0.4	10.5%	234
382	Measuring and Controlling Devices	5,595	1.6	8.3%	431

*Location quotient is the relative concentration of industry employment in the region compared to the nation as a whole (nation=1.0).

Source: Ohio Bureau of Employment Services, Covered Employment and Payroll Data (ES202 Data), Edited by Cleveland State University's Urban Center.

Payroll Per Employee

Overall, the Instruments and Controls cluster wages are nearly the same as the manufacturing sector in the NEO region as a whole. In 1995, average payroll per employee for the cluster was about $33,300, compared to the average payroll per employee in manufacturing of $33,900 (Table 2). However, average payroll per employee in the electronic components and accessories segment was lower than that of manufacturing in the region, at $25,843. Therefore, the measuring and controlling devices segment provides better-paying jobs than manufacturing jobs in the region on average. Payroll per employee in this segment was $36,620 in 1995.

Payroll per employee increased 7.9 percent since 1989 for the cluster overall and also increased for both its segments. This is because total payroll at companies in the cluster grew faster than employment. This may indicate higher productivity on the part of workers in the cluster, or may indicate that the increase in employment over the time period was in higher-paying occupations. The measuring and controlling devices segment experienced a particularly large increase in average payroll per employee of 10 percent over the time period.

In 1995, average payroll per employee in the NEO cluster was just 82 percent of nationwide industry average. Payroll per employee in the electronic components and accessories segment is even lower when compared to the nation as a whole (64 percent.) This fact reflects the relatively low cost-of-living and required wages and salaries in the NEO region, and is regarded as an important competitive advantage by companies in the cluster. It may also be an indication that NEO companies in this cluster are smaller on average than in the national industry, and, therefore, less likely to be competitive in terms of wages.

Table 2

SIC	Description	Payroll Per Employee 1995	Payroll Per Employee % Change 1989-95	Payroll Per Employee Relative to the Nation 1995
	CLUSTER TOTAL	**$33,332**	**7.9%**	**0.82**
367	Electronic Components and Accessories	$25,843	2.1%	0.64
382	Measuring and Controlling Devices	$36,620	10.0%	0.88

Source: Ohio Bureau of Employment Services, Covered Employment and Payroll Data
(ES202 Data.)
Edited by Cleveland State University's Urban Center.

Productivity and Export Strength

In 1992, the average productivity of the cluster was five percent higher than that of all NEO industries, shown by the relative productivity measure of 1.05. The electronic components and accessories segment was much more productive than the region as a whole, 29 percent higher, while the measuring and controlling devices segment was less productive, with a relative productivity measure of 94 percent.

Companies in the Instruments and Controls cluster export a significant majority of their products: in 1992, exports accounted for 74 percent of the cluster's output. The cluster accounts for one percent of the NEO region's total exports in that year.

Table 3

SIC	Description	Productivity * Relative to the Region 1992	Percent of Output Exported Outside of the Region 1992	Percent of Total Region's Exports 1992
	CLUSTER TOTAL	1.05	74%	1.0%
367	Electronic Components and Accessories	1.29	74%	0.3%
382	Measuring and Controlling Devices	0.94	74%	0.7%

*Proxy for productivity based on gross metropolitan product per employee

Source: Cleveland State University's Urban Center

Firm Size

As shown in Table 4, the significant majority of firms in the cluster are small and medium-sized: a full 97 percent of the core cluster firms have less than 100 employees. However, the cluster does include a number of large establishments, which account for 59 percent of the total employment of the cluster. The average firm size for the cluster overall is 57 employees.

Table 4

Firm Size	% of Cluster Firms	% of Cluster Employment	Average Firm Size
1-24	51%	8%	9

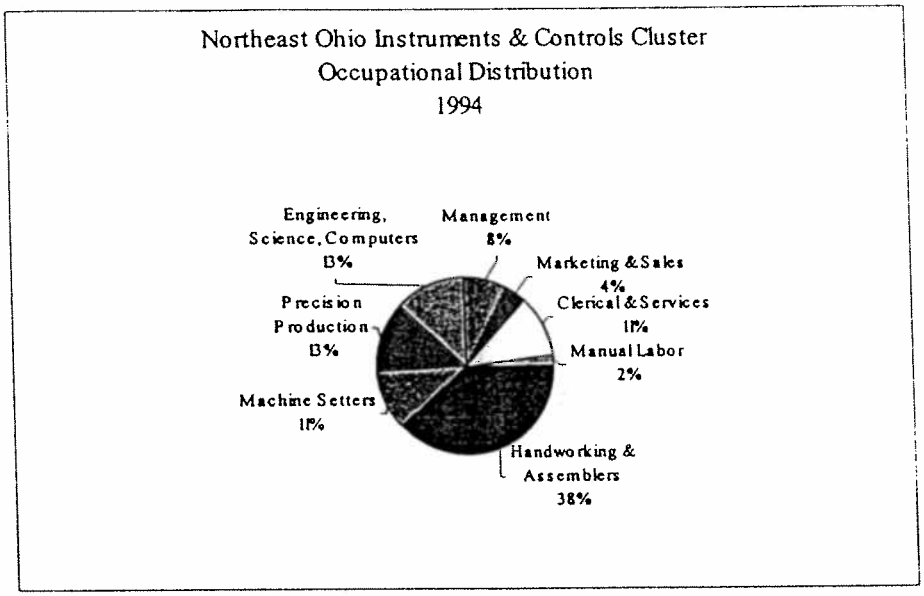
25-99	36%	33%	52
100+	13%	59%	262

Source: Ohio Bureau of Employment Services, Covered Employment and Payroll Data (ES202 Data.)
Edited by Cleveland State University's Urban Center.

Occupational Distribution

Figure 1 shows the occupational distribution of the NEO Instruments and Controls cluster as of 1994.

Figure 1



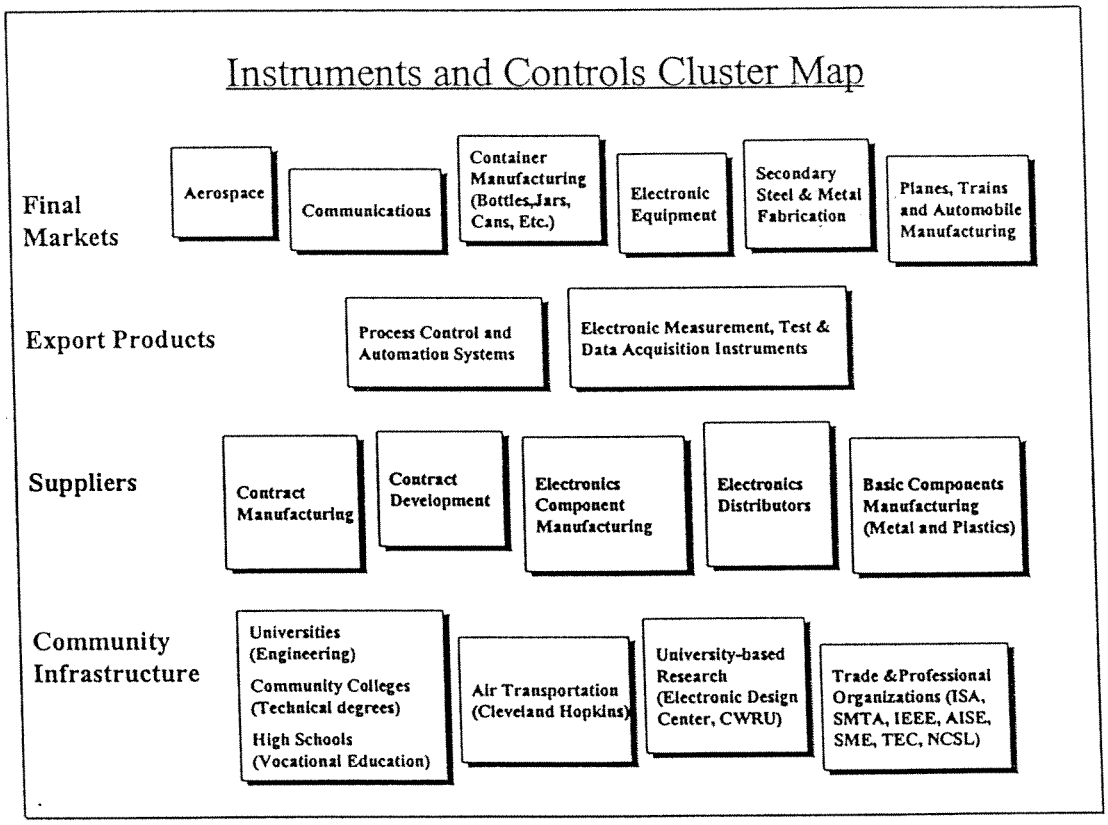
Source: Ohio Bureau of Employment Services, Occupation by Industry Data.

Overall, jobs in this cluster are relatively highly skilled. Engineers, scientists and computer-related occupations make up a sizable proportion of total employment (13 percent), indicating the cluster's strong need for highly-skilled technical talent requiring four-year college degrees or more. Precision production and handworkers and assemblers together account for over half of the cluster's total employment, while manual laborers make up a very small two percent. Clerical and services jobs make up just 11 percent of total employment.

Cluster Relationships

Figure 2 illustrates the structure of the Northeast Ohio Instruments and Controls cluster. The four components of the cluster are final markets (customers), export products (the core companies of the cluster), suppliers, and community infrastructure.

Figure 2



Final Markets

The NEO Instruments and Controls cluster's customers include almost all goods-producing industries. Primary users of the region's products include aerospace, communications, electronic components and equipment, food and beverage container manufacturing, glass container manufacturing, metal fabrication, secondary steel, and transportation. A secondary tier of customers includes the chemicals, paper and paper products, plastics, and wood products industries and others.

The cluster's customers are located worldwide, primarily in the United States, Europe, and the Pacific Rim. In the U.S., Chicago, Detroit, and

California are strong markets, but the cluster's customers are located in almost every state. A few companies in the cluster have customers located in Northeast Ohio, while others have almost none in the region.

Export Products

The export products segment of the cluster includes the core companies of this cluster: those that sell their products outside of the NEO region and largely drive the performance of the cluster. Examples of these companies' export products include machine vision systems; electronic measurement and data acquisition instruments; electronic test and measurement equipment for calibration and production test applications; and automation systems to drive, control, and manage industrial processes (programmable logic controllers, input-output devices, comllers, ions devices, and user.interfaces.)

Suppliers

The cluster has two tiers of suppliers, based on the nature of the contract between the companies and the sophistication of the supplier's products. First tier suppliers include contract manufacturers, contract developers, and makers of high-tech electronic componentry. Products and services sold by this tier are sophisticated in terms of technology and tend to be custom rather than standard. Therefore, the relationship between these suppliers and the core firms of the cluster tends to involve substantial interaction and/or collaboration.

Contract manufacturers are companies to which Instruments and Controls companies outsource their production and assembly operations. The presence of contract manufacturers in Northeast Ohio is critical to companies in this cluster, since most companies outsource some, if not all, of their manufacturing to local contract manufacturers. Northeast Ohio has a good base of contract manufacturers: as one industry leader said, "it's not hard to get something built here." Area contract manufacturers range from basic electronics assembly to surface mount assembly, to the packaging of bare die and integrated circuits. Contract manufacturers may or may not be involved in the design and implementation of the technology. Two contract manufacturers serving the NEO Instruments and Controls cluster are Libra Industries and Valtronic Technology.

Contract developers have emerged over the last two years in this industry. These are contract research and development companies with high-tech expertise to which cluster companies outsource specific technology design needs. According to industry leaders, a few of these companies exist in Northeast Ohio, but more are needed.

Most makers of more sophisticated electronic componentry (such as integrated circuits and circuit boards) are located in the high-tech centers of the electronics industry: Silicon Valley in Northern California, the Pacific Northwest, Texas, the Carolinas, Georgia, and the East Coast (Boston.) The NEO Instruments and Controls cluster is at a disadvantage; in general, the more sophisticated the technology needed, the less likely that local suppliers are available.

A second tier of suppliers includes local electronics distributors (such as Pioneer Standard and Arrow Electronics) manufacturers' representatives, and makers of sheet metal, machine and plastic parts. This tier tends to sell more standard products, primarily components and parts, and is quite strong in NEO.

The relationship between the core companies, contract manufacturers and second tier of suppliers is complex. The second tier supplies products to the contract manufacturers as well as the core companies, and the contract manufacturers may buy directly from the second tier suppliers. However, it is often the case that the core company which outsources to contract manufacturers will retain the buying relationship with the second tier suppliers, buying directly and having the components shipped to the contract manufacturer. Such a relationship allows the core company to maintain control over quality, keep from being a captive of the contract manufacturer, and benefit from economies of scale, buying in higher volume.

Community Infrastructure

The Instruments and Controls cluster relies heavily on local universities for entry-level engineers and business school graduates; local community colleges for two-year technical degree graduates; and high school and county-level vocational education programs for entry-level assembly technicians.

Air transportation is critical for the companies in this cluster, less to transport its products, than to carry sales, service, and engineering staff to and from customers worldwide.

Research at local universities supports the Instruments and Controls cluster to some extent. Foremost is the Electronic Design Center, a microelectronic research facility at Case Western Reserve University under the direction of Dr. C.C. Liu.

A number of companies in this cluster are active in a variety of trade and professional associations, in their local chapters (if they exist) and nationally. In general, however, industry leaders are divided on the benefits of membership in such organizations. Some industry executives gain from their

participation, citing the knowledge transfer and networking which occurs at trade shows, through research papers, etc. Others are members of these organizations solely for public relations reasons, and are reluctant to share technical knowledge or expose their engineering staffs to other companies.

Competing Regions

Competitors to this cluster are located worldwide, and most companies do not have direct competitors in Northeast Ohio. A number of the companies in this cluster are dominant, or one of very few companies, in their market niches. An exception is in the process control instrumentation segment, in which a few strong competitors are located within Northeast Ohio. For the cluster as a whole, competitors are located across the U.S., in Europe, and in the Pacific Rim.

Cluster Evolution

The Northeast Ohio (NEO) Instruments and Controls cluster is an outgrowth of traditional numerical controls industry and the strength of the overall electronic equipment manufacturing industry in the 1960s and early 1970s. During that time, there was a base of large electronics manufacturers, but the region has lost a number of these companies over the years. A general migration south occurred in the 1970s and 1980s due to union issues. More recently, companies have been lost due to industry consolidation, primarily in instances when local companies have operations elsewhere and consolidate their local operations into these other locations. The question remains why the out-of-state operations were not consolidated in NEO. Further, no companies in the industry have relocated in NEO, and new companies appear to be developing only in the aforementioned high-tech centers.

There have, however, been a number of start-up companies in the cluster over this time period: one industry leader noted over 20 start-ups. Examples include Tegam, IOtech, Dataq, and Quatek. These companies have since grown to differing sizes and degrees of success, but, in general, are smaller companies than those that have left the region. This trend towards the development of smaller, entrepreneurial, fast-moving companies, rather than industry giants is consistent with the electronics industry in general.

As one industry executive put it, the "heart" of the NEO Instruments and Controls cluster has traditionally been in industrial and process controls, including programmable logic controllers. Companies in this segment include Allen-Bradley (Rockwell Automation), Bailey Controls, and Cleveland Motion Controls. Some of the start-up companies over the past twenty or so

years are in this segment, while more are in the electronic measurement and data acquisition instruments segment. Interestingly, a number of companies in this cluster began 25 years or so ago as producers of mechanical equipment, then purposely evolved into electronics equipment manufacturers in order to participate in what they correctly saw as an industry with tremendous growth opportunities.

Growth in Contract Manufacturing

Over the past 10 years, there has been a general trend toward the use of contract manufacturers. The major instrument and controls companies are increasingly focusing on the design and marketing of their products and farming out the steps in between, such as packaging printed circuit boards and assembling them into products. Contract manufacturing is a growing segment of the electronics business in general, since building in-house requires increasingly high cost capital equipment. The contract manufacturing market has emerged in large part due to the pace of technological innovation. High-tech markets are becoming increasingly competitive, and companies are being forced to focus on their core competencies. Most original equipment manufacturers (OEMs) have realized that their core competencies are in engineering, research and development, and sales and marketing, and, therefore, outsource much if not all of their manufacturing.

Contract manufacturers including NEO contract manufacturers tend to be relatively small. Yet NEO companies have both local and non-local customers in the instrumentation and controls industry, as well as in biomedical instruments, telecommunications, and auto manufacturing.

Cluster Potential

The primary external factors driving the performance of the Instruments and Scientific cluster are continued advancements in technology and increased global competition. A number of local region-specific factors bear on the performance of the cluster.

External Factors

- **Rapid technological advancement and heightened global competition combine to present considerable opportunities and challenges for the cluster.**

  In the words of one industry leader, the rapid advancements in computer technology and their applications in industry over the past two decades have "turned the industry upside down" and will continue to do so.

  Traditionally, the primary products of the Instruments and Controls cluster were mechanical or pneumatic instruments (for example, 'push buttons' and numerical controls), but over the past 20 years, industrial instrumentation has become increasingly electronic, that is, hardware and software-based. The transition to computer-based control systems and instrumentation has been difficult for some older companies. The relatively new companies in the cluster see this as an advantage as these companies began in Mac and Windows environments and have not had to make the same transition.

  Importantly, the pace of technological improvement is increasing. For example, improvements in microprocessor technology over the past two years have meant that process capability has increased tenfold at half the previous cost. Almost all industrial equipment and systems have some computer or electronic components. To the companies in this cluster, this environment represents tremendous growth opportunities as well as challenges.

  The globalization of the industrial economy holds substantial opportunities for the NEO Instruments and Controls cluster. Heightened global competition drives companies to cut costs and increase the efficiency of production. In this environment, customers also desire increased quality, boosting demand for data acquisition and testing instrumentation for quality control. These trends directly benefit the controls and instrumentation industry.

Companies in this cluster face global competitors as well. Many of these companies' primary competitors are massive global companies with strong financial backing and tremendous market power, such as Siemens, Mitsubishi, and Toshiba.

The combination of rapid technological development and an increasingly global economy means that the cluster faces considerable opportunities and challenges in bridging differences in language, standards, cultures, business methods, and technologies to form a world user basis for its products. Much of the growth in demand for the cluster's products will come from growing markets overseas, particularly the newly industrializing countries.

Internal Drivers

Positives

- **Northeast Ohio's (NEO's) supply of contract manufacturers is ample, and is certain to grow as long as the regional cluster grows.** This fact is important as an enabling influence on the size and mass of the cluster.

- **NEO has a considerable base of intellectual property in this cluster.** The region has a conglomeration of automation, controls, and instruments companies, many of which were and are pioneers of the state-of-the-art technology in this industry.

- **Many companies in the cluster have a diverse customer industry mix.** As a result of this diversity, the cluster is relatively recession-proof and is a stabilizing influence on the region.

- **NEO has competitive wages and a low cost of living relative to the cluster's competing regions, giving the cluster a competitive advantage in labor costs and pricing.**

- **The cluster benefits from a workforce with a strong "Midwestern" work ethic at all levels.** Most companies in the cluster believe that the average production-level worker in NEO is serious and hard-working, especially relative to "nice-weather" regions.

Negatives

- **Companies in the NEO Instruments and Controls cluster are seriously hampered by a regional scarcity of high-tech talent.** The scarcity includes not only computer and electronics engineering graduates, but also sales and marketing personnel with technical expertise. Software engineering is the most rapidly growing occupation in the cluster, and also the one with the shortest supply. A number of companies in the cluster see this small potential employee pool as a severe limitation to their growth prospects in the region, especially in R&D operations. One industry executive said that his company could increase its size by four to five times if recruiting were easier. Moreover, the competitiveness of the local engineering labor market makes companies hesitant to collaborate since it exposes their engineers to other companies.

- **The lack of direct international flights at Cleveland Hopkins Airport is also a restraint on the cluster's future growth prospects.** As noted, companies in this cluster sell to customers worldwide; therefore, a steady stream of sales, service, and engineering personnel travels to and from customers worldwide. Cleveland Hopkins is regarded as a B-grade airport by companies in this cluster. Its status as the hub of Continental Airlines is critical, but the lack of direct international flights means that trips to Europe and the Far East are a day longer than necessary. Companies in this cluster see this lack of accessibility as a considerable disadvantage of a NEO location.

Requirements for Cluster Vitality

- **NEO must develop a stronger focus on high-tech engineering, technical two-year degrees, and vocational education.** The chief drawback of the NEO region for companies in the Instruments and Controls cluster is the short supply of computer and electrical/electronics engineering talent.

  Computer and electrical engineering specialties lacking in NEO include software, operating systems, radio frequency, high frequency, temperature measurement, analog to digital, and graphical user interfaces. Also lacking are mechanical engineers with expertise in electronic packaging. Not only are these engineers in short supply, but the "top echelon" of engineers appears to be unavailable in the region, and it is quite difficult to recruit them from the high-tech centers of the industry. In order to support the further development of this cluster, local universities must expand their engineering programs, both in terms of the number of

graduates, and in terms of a stronger focus on the high-tech specialties which are required by companies in the cluster.

The technical skills of the entry-level workforce is also a problem, mainly at the production level, a limitation affecting contract manufacturers in particular. For one company, the biggest limitation to growth in 1997 was the inability to fill vacancies for entry-level technicians and assembly workers. An expansion of technical two-year degree programs at the community college level and vocational education at the high school level are necessary to support the cluster.

- **Cleveland Hopkins Airport must gain the ability to provide direct international flights.** A number of industry executives maintain that, if Cleveland Hopkins does not get direct international flights in the near future, they may consider expanding outside the region. This threat is especially true of plans to expand R&D, sales, and service operations. Development of these operations Develop the region would obviously restrain the development of the cluster, both in size and mass.

- **Research collaboration between local educational institutions and cluster companies must be developed and strengthened.** Leaders at companies in this cluster cite a need for a stronger interface between research bases at the local universities and the industry. A few companies have done collaborative work with the Electronic Design Center, a microelectronic research facility at Case Western Reserve University. According to one industry executive, this facility has the capacity to do ground-breaking research in miniaturization, from which technology and products could be developed and commercialized if there were more collaboration with local companies.

  Beyond this forum, little exists for the cluster in the way of university research in high accuracy electronics. For the most part, industry leaders have found it difficult to interface with the local universities although a number claim they have attempted to do so. Some mentioned activity with the Cleveland Advanced Manufacturing Program, Inc. but claim that CAMP has developed a focus on mechanical manufacturing rather than electronics. Cluster leaders cite the need for research institutions to which companies could give grants or collaborate with in researching and developing various technologies. Models of these institutions include Carnegie Mellon, University of Rochester, the University of Michigan, Ann Arbor, and M.I.T. The lack of such research institutions is a significant disadvantage for the cluster, perhaps the greatest disadvantage in terms of the cluster's potential for developing a critical mass of intellectual capital and R&D in NEO.

- **Cluster companies must have the financial support of local commercial and investment banks.** Companies in this cluster have had mixed experience with local access to capital. Some executives maintain that financial capital for high-technology is easy to access in the region since there are relatively few high-tech companies vying for funding and, therefore, relatively few "stars." Others have had substantial difficulty with local financial institutions, citing their lack of knowledge and understanding of the operations and needs of high-technology companies. Local institutions perceive the industry as riskier than the typical Midwestern business, and do not understand how to approach financing for companies which have extensive R&D expenses, low inventory turnover, and are technology and intellectual capital-based rather than asset-based. Industry executives do say, however, that the high-tech industry in NEO is well-respected in the global capital community.

- **The national image of Cleveland and the NEO region must continue to improve.** Given the short supply of high-tech engineers and technical management in NEO, companies in this cluster must often recruit from outside the region, usually from the high-tech centers of the industry. For most companies, recruiting people from outside NEO has been nearly impossible for a variety of reasons, but particularly due to the image of Cleveland as a small, depressed Midwestern city with bad weather. The revitalization of Cleveland in the eyes of the nation over the past few years has helped considerably, and industry leaders claim that if this improvement continues, recruiting high-tech talent from outside the region will likely become easier.

- **Cluster companies must see evidence of a strategy on the part of the region and/or the state of Ohio to support the cluster.** A number of industry executives in this cluster contend that there is no clear strategy on the part of the region or the State of Ohio to support the Instruments and Controls industry or the electronic equipment industry in general.

  These companies offer relatively high-wage and highly-skilled careers, provide comfortable working environments for their laborers, are relatively clean in terms of noise and pollutants, and the industry is expected to grow substantially in the coming years. Industry leaders are frustrated that there is little support for these companies in NEO, and no apparent strategy to attract other instruments and controls manufacturers to Ohio. Other states appear to be actively developing their electronics industries (for example, Georgia, California, and North and South Carolina). Some industry executives are concerned that if the

industry is not promoted in the region, companies will continue to leave or consolidate their high-tech operations elsewhere. There have been recent efforts in the NEO region, particularly on the part of Cleveland Tomorrow, to develop ways to nurture high-technology-based companies, but these appear to be focused on the biotechnology and biomedical industry.

In general, the NEO region must recognize that it is in direct competition with other regions for the companies in the Instruments and Controls cluster, and must offer support through financing, tax incentives, research monies, infrastructure, and services. Companies in this cluster frequently receive sizable offers to relocate from other states, including tax abatements and free building and land funding, but for the most part, they do not know what is available in terms of tax and financing support in NEO.

Opportunities for Collaborative Action

Companies in the Instruments and Controls cluster have varying degrees of interest in inter-company collaboration. Industry leaders are concerned with two issues which hamper direct collaboration. First, the short supply of qualified high-tech engineers in the region creates a very competitive labor market in engineering. Cluster companies are protective of their engineers, who are difficult to replace if lured by other companies. Companies are therefore hesitant to collaborate if it means exposing their engineers to other companies at the risk of losing talent. A second issue is the competitive nature of R&D in the cluster: companies are hesitant to share technology and challenges with competitors. The cumulative effect of these issues is that collaboration that has occurred in the cluster has not often been between competitors.

In general, companies in this cluster are less interested in collaborating directly with one another, and more interested in developing capabilities and ties to regional research bases and developing relationships with local universities and schools to improve the Northeast Ohio (NEO) labor supply. This said, two opportunities for collaborative action which would be relatively certain to have the support of most of the cluster are:

- **Partnerships with local universities to strengthen programs in high-tech engineering and high-tech-oriented business, as well as to develop recruiting channels from these programs to firms in the cluster.** The relative lack of high- tech talent in the region and the difficulty in recruiting from outside is the foremost issue for most companies in this cluster, and efforts to improve the situation are almost guaranteed to have their participation and support.

- **Developing research bases to support the cluster at local universities and research organizations. These research institutions may then provide a basis for inter-company collaboration.** Industry executives maintain that there may be pertinent research already taking place at the local universities, but that the universities do not market their research well and often do not know "what or who they have" to offer the cluster. The Electronic Design Center at Case may be a starting point in these efforts, but its focus is primarily on microelectronics and miniaturization, which may not serve the needs of the cluster overall.

Some industry leaders do show a considerable amount of interest in collaboration and networking with other companies in the NEO and in developing and strengthening the forums for regional interaction. These

leaders see the need for forums for technological collaboration as well as for the sharing of business experiences among peer high-technology companies.

The Pittsburgh area was cited as a model for the approach that NEO could take to generate interaction and support for the Instruments and Controls cluster. In particular, the Pittsburgh High Technology Council could serve as a model for an industry organization which could provide unity and a forum for networking and collaboration. The Pittsburgh High Technology Council is an organization supporting the local high-tech industry, bringing together industry, higher educational institutions, and the community in encouraging the growth of the high-tech industries in the region. According to some in the NEO cluster, this organization has been successful in giving the industry a forum for interaction and has helped in part to retain and attract high-tech firms to the Pittsburgh area.

Any efforts to bolster collaboration within the Instruments and Controls cluster must include NEO contract manufacturers and developers as well as the core companies of the cluster. Further, a number of industry leaders stress that collaborative initiatives in this cluster should be directed at the operating management level, rather than at the executive management level. For smaller companies, the operating management level is the same as the executive management level.

Lastly, to be successful, collaborative initiatives should involve those managers whom one industry leader called the "integrators" of the cluster. Integrators are those managers who are aware of, interested in, and may already be active in developing their companies' working relationships within the region. While integrators do not exist at every cluster firm, these individuals should obviously be targeted for participation in collaborative initiatives because they are already in the business of collaboration.

Appendix

The Northeast Ohio region includes the following eight counties: Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Summit, and Portage.

Cluster Definition by Standard Industrial Classification (SIC) code:

SIC	Description
367	Electronic Components and Accessories
382	Measuring and Controlling Devices